

CLAIMS

1. A measuring device for determining concentration of a first material in an environment in contact with the device, which first material reacts within said device in presence of a catalyst with a second material to form a third material; and which device comprises:
 - a membrane comprising a body, a surface in contact with said environment, and at least one discrete hydrophilic region in communication with said body, wherein said hydrophilic region is permeable to said first and second materials, and said body is otherwise permeable to said second material and essentially impermeable to said first material, wherein both said first and second materials diffuse into said device from said environment through said surface;
 - a catalyst within said hydrophilic region wherein reaction of said first and second materials occurs;
 - at least one critical zone within said hydrophilic region containing said catalyst;
 - at least one sensor, having a surface communicating with at least one said hydrophilic region and sensitive to either said second material or said third material and producing a signal indicative of the concentration of said second or third material in said region; and
 - a control responsive to said signal for comparing said signal to a reference to determine the concentration of said first material in said environment.
2. The measuring device of claim 1, wherein the environment is mammalian tissue.
3. The measuring device of claim 1, wherein the environment is a biological fluid.

4. The measuring device of claim 1, wherein the environment is
2 contacted by implantation of the sensor into an individual.

4 5. The measuring device of claim 1, wherein the bodily fluid is
removed from an individual for contact with the sensor outside of the
6 body.

8 6. The measuring device of claim 1, wherein the first material is
glucose.

10 7. The measuring device of claim 6, wherein the catalyst is glucose
12 oxidase.

14 8. The measuring device of claim 1, wherein the first material is
lactate.

16 9. The measuring device of claim 8, wherein the catalyst is lactate
18 oxidase.

20 10. The measuring device of claim 1, wherein the first material is
cholesterol.

22 11. The measuring device of claim 10, wherein the catalyst is
24 cholesterol oxidase.

26 12. The measuring device of claim 1, wherein the second material is
oxygen.

28 13. The measuring device of claim 1, wherein the third material is
30 hydrogen peroxide.

14. The measuring device of claim 1, wherein the membrane body is
2 selected from the group of materials consisting of silicone-containing,
4 ethylene-containing and propylene-containing polymers with and without
6 fluorine, silicone rubbers, polyethylene, polypropylene, teflons and
8 polyfluorinated hydrocarbons, poly-methylmethacrylates, poly-carbonates,
10 poly-hydroxyethylmethacrylate, and co-polymers and combinations
12 thereof.

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15. The measuring device of claim 1, wherein the hydrophilic region is
16 selected from the group of materials consisting of polyacrylamide gels,
18 gluteraldehyde cross-linked proteins, vinyl pyrrolidone, alginates, ethylene
20 oxide, acrylamide, methylacrylic acids, polyhydroxyethyl-methacrylate
22 and its derivatives, and co-polymers and combinations thereof.

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16. The measuring device of claim 1, wherein the hydrophilic region has
20 essentially an identical surface area on the inner and outer faces of the
22 membrane.

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17. The measuring device of claim 1, wherein the hydrophilic region has
20 a larger surface area on the inner face of the membrane as compared to
22 the outer face of the membrane.

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18. The measuring device of claim 1, wherein the membrane contains a
24 plurality of hydrophilic regions.

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19. The measuring device of claim 18, wherein the plurality of
28 hydrophilic regions are a variety of sizes.

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20. The measuring device of claim 1, wherein an average vector
30 direction of diffusion of said first material in said critical zone is

substantially parallel to an average vector direction of diffusion of said
2 first material in said hydrophilic region.

4 21. The measuring device of claim 1, comprising a critical zone with an
average equivalent radius and a length, wherein said average equivalent
6 radius of said critical zone is less than said length of said critical zone,
wherein said equivalent radius is obtained by dividing the cross-sectional
8 area of said critical zone by pi and then taking a square root of the
resulting quantity.

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12 22. The measuring device of claim 1, wherein an average vector
direction of diffusion of said first material in said critical zone is
14 substantially parallel to an average vector direction of diffusion of said
first material in said hydrophilic region and an average equivalent radius
16 and a length, wherein said average equivalent radius of said critical zone is
less than said length of said critical zone, wherein said equivalent radius is
18 obtained by dividing the cross-sectional area of said critical zone by pi and
then taking a square root of the resulting quantity.

20 23. The measuring device of claim 1, wherein the critical zone is
coincident with the hydrophilic region.

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24 24. The measuring device of claim 1, wherein a single hydrophilic
region corresponds to more than one sensor.

26 25. The measuring device of claim 1, wherein the base of the
hydrophilic region is nearly identical in area to the area of its
28 corresponding sensor.

30 26. The measuring device of claim 1, wherein the base of the
hydrophilic region is larger in area than its corresponding sensor.

27. The measuring device of claim 1, wherein more than one
2 hydrophilic region corresponds to a single sensor.

4 28. The measuring device of claim 1, wherein a single hydrophilic
region corresponds to a plurality of sensors.